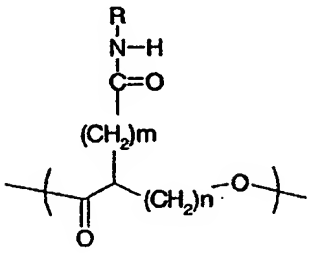
CLAIMS

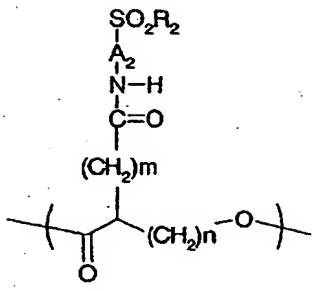
1. A polyhydroxyalkanoate comprising one or more units represented by the chemical formula (1) in a molecule,



(1)

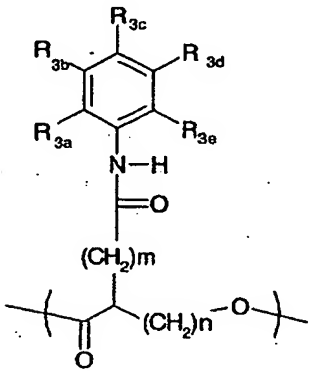
Wherein R represents $-A_1-SO_2R_1$, R_1 represents OH, a halogen atom, ONa, OK, or OR_{1a}, R_{1a} and A_1 each independently represent a substituted or unsubstituted aliphatic hydrocarbon structure, a substituted or unsubstituted aromatic ring structure, or a substituted or unsubstituted heterocyclic structure, n represents an integer selected from 1 to 4, m represents an integer selected from 0 to 8, and when multiple units exist, R, R_1, R_{1a}, A_1, m, and n each independently have the above meaning for each unit.

2. A polyhydroxyalkanoate according to claim 1, comprising one or more units each represented by the chemical formula (2), (3), (4A), or (4B) in a molecule as the units of the chemical formula (1),



(2)

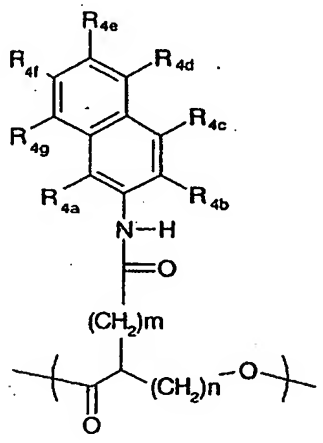
wherein R_2 represents OH, a halogen atom, ONa, OK, or OR_{2a}, R_{2a} represents a linear or branched alkyl group having 1 to 8 carbon atoms, or a substituted or unsubstituted phenyl group, A_2 represents a linear or branched alkylene group having 1 to 8 carbon atoms, n represents an integer selected from 1 to 4, m represents an integer selected from 0 to 8, when multiple units exist, A_2, R_2, R_{2a}, m, and n each independently have the above meaning for each unit,



(3)

wherein R_{3a}, R_{3b}, R_{3c}, R_{3d}, and R_{3e} each independently represent SO_2R_{3f} (R_{3f} represents OH, a halogen atom,

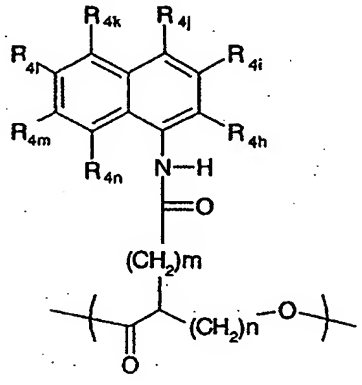
ONa, OK, or OR_{3f1} (R_{3f1} represents a linear or branched alkyl group having 1 to 8 carbon atoms, or a substituted or unsubstituted phenyl group)), a hydrogen atom, a halogen atom, an alkyl group having 1 to 20 carbon atoms, an alkoxy group having 1 to 20 carbon atoms, an OH group, an NH_2 group, an NO_2 group, $COOR_{3g}$ (R_{3g} represents an H atom, an Na atom, or a K atom), an acetamide group, an OPh group, an NHPh group, a CF_3 group, a C_2F_5 group, or a C_3F_7 group (Ph represents a phenyl group), and at least one of these groups represents SO_2R_{3f}, n represents an integer selected from 1 to 4, m represents an integer selected from 0 to 8, and when multiple units exist, R_{3a}, R_{3b}, R_{3c}, R_{3d}, R_{3e}, R_{3f}, R_{3f1}, R_{3g}, m, and n each independently have the above meaning for each unit,



(4 A)

Wherein R_{4a}, R_{4b}, R_{4c}, R_{4d}, R_{4e}, R_{4f}, and R_{4g} each independently represent SO_2R_{4o} (R_{4o} represents OH, a

halogen atom, ONa, OK, or OR_{4o1} (R_{4o1} represents a linear or branched alkyl group having 1 to 8 carbon atoms, or a substituted or unsubstituted phenyl group)), a hydrogen atom, a halogen atom, an alkyl group having 1 to 20 carbon atoms, an alkoxy group having 1 to 20 carbon atoms, an OH group, an NH_2 group, an NO_2 group, $COOR_{4p}$ (R_{4p} represents an H atom, an Na atom, or a K atom), an acetamide group, an OPh group, an NHPh group, a CF_3 group, a C_2F_5 group, or a C_3F_7 group (Ph represents a phenyl group), and at least one of these groups represents SO_2R_{4o}, n represents an integer selected from 1 to 4 and m represents an integer selected from 0 to 8, and wherein multiple units exist, R_{4a}, R_{4b}, R_{4c}, R_{4d}, R_{4e}, R_{4f}, R_{4g}, R_{4o}, R_{4o1}, R_{4p}, m, and n each independently have the above meaning for each unit),

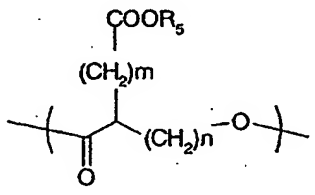


(4B)

wherein R_{4h}, R_{4i}, R_{4j}, R_{4k}, R_{4l}, R_{4m}, and R_{4n} each

independently represent SO_2R_{4o} (R_{4o} represents OH, a halogen atom, ONa, OK, or OR_{4o1}, (R_{4o1} represents a linear or branched alkyl group having 1 to 8 carbon atoms, or a substituted or unsubstituted phenyl group)), a hydrogen atom, a halogen atom, an alkyl group having 1 to 20 carbon atoms, an alkoxy group having 1 to 20 carbon atoms, an OH group, an NH_2 group, an NO_2 group, $COOR_{4p}$ (R_{4p} represents an H atom, an Na atom, or a K atom), an acetamide group, an OPh group, an NHPh group, a CF_3 group, a C_2F_5 group, or a C_3F_7 group (Ph represents a phenyl group), and at least one of these groups represents SO_2R_{4o}, n represents an integer selected from 1 to 4, m represents an integer selected from 0 to 8, and wherein multiple units exist, R_{4h}, R_{4i}, R_{4j}, R_{4k}, R_{4l}, R_{4m}, R_{4n}, R_{4o}, R_{4o1}, R_{4p}, m, and n each independently have the above meaning for each unit.

3. A polyhydroxyalkanoate comprising one or more units represented by the chemical formula (5),

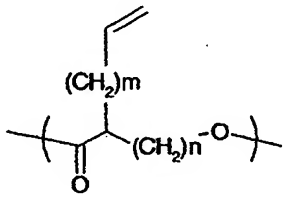


(5)

Wherein R_5 represents a hydrogen atom, a group for forming a salt, or R_{5a}, R_{5a} represents a linear or

branched alkyl or aralkyl group having 1 to 12 carbon atoms, or a group having a saccharide, n represents an integer selected from 1 to 4, m represents an integer selected from 0 to 8, when n = 4, R_5 represents only a group having a saccharide for m = 0, and when multiple units exist, R_5, R_{5a}, m, and n each independently have the above meaning for each unit.)

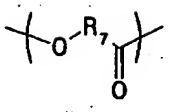
4. A polyhydroxyalkanoate comprising one or more units represented by the chemical formula (6),



(6)

wherein n represents an integer selected from 1 to 4, when n represents an integer selected from 1, 2, and 4, m represents an integer selected from 0 to 8, when n = 3, m represents an integer selected from 0 and 2 to 8, and when multiple units exist, m and n each independently have the above meaning for each unit.

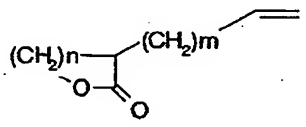
5. A polyhydroxyalkanoate according to any one of claims 1 to 4, further comprising a unit represented by the chemical formula (7) in a molecule,



(7)

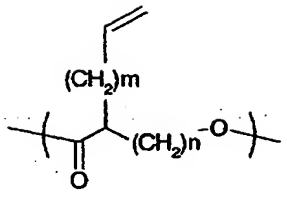
wherein (R_7 represents a linear or branched alkylene group having 1 to 11 carbon atoms, an alkyleneoxyalkylene group each alkylene of which has 1 or 2 carbon atoms (alkylene groups each independently have 1 or 2 carbon atoms), or an alkylidene group having 1 to 5 carbon atoms which may be substituted by aryl, and when multiple units exist, R_7's each independently have the above meaning for each unit.

6. A method of producing a polyhydroxyalkanoate represented by the chemical formula (6), comprising the step of polymerizing a compound represented by the chemical formula (8) in the presence of a catalyst,.



(8)

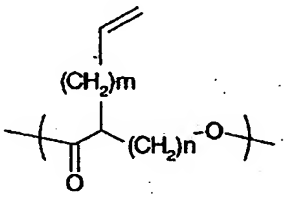
wherein n represents an integer selected from 1 to 4 when n represents an integer selected from 1, 2, and 4, m represents an integer selected from 0 to 8, and when n = 3, m represents an integer selected from 0 and 2 to 8,



(6)

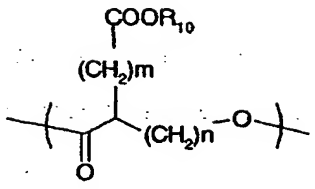
wherein n represents an integer selected from 1 to 4, when n represents an integer selected from 1, 2, and 4, m represents an integer selected from 0 to 8, when n = 3, m represents an integer selected from 0 and 2 to 8, and when multiple units exist, m and n each independently have the above meaning for each unit.

7. A method of producing a polyhydroxyalkanoate containing a unit represented by the chemical formula (10), comprising the step of oxidizing a double bond portion of a polyhydroxyalkanoate containing a unit represented by the chemical formula (9),



(9)

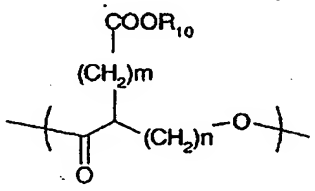
wherein n represents an integer selected from 1 to 4 and m represents an integer selected from 0 to 8, when multiple units exist, m and n each independently have the above meaning for each unit,



(10)

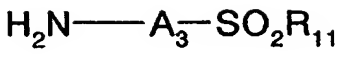
wherein R_{10} represents a hydrogen atom or a group for forming a salt, n represents an integer selected from 1 to 4, m represents an integer selected from 0 to 8, and when multiple units exist, m, n, and R_{10} each independently have the above meaning for each unit.

8. A method of producing a polyhydroxyalkanoate containing a unit represented by the chemical formula (1), comprising the step of subjecting a polyhydroxyalkanoate containing a unit represented by the chemical formula (10) and at least one kind of amine compound represented by the chemical formula (11) to a condensation reaction,



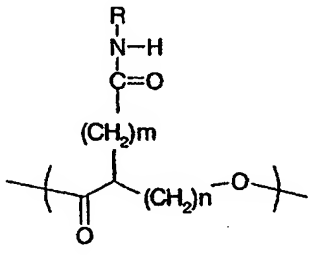
(10)

Wherein R_{10} represents hydrogen or a group for forming a salt, n represents an integer selected from 1 to 4, m represents an integer selected from 0 to 8, and when multiple units exist, m, n, and R_{10} each independently have the above meaning for each unit,



(11)

wherein R_{11} represents OH, a halogen atom, ONa, OK, or OR_{11a}, R_{11a} and A_3 are each independently selected from groups each having a substituted or unsubstituted aliphatic hydrocarbon structure, a substituted or unsubstituted aromatic ring structure, or a substituted or unsubstituted heterocyclic structure, and when multiple units exist, R_{11}, R_{11a}, and A_3 each independently have the above meaning for each unit,



(1)

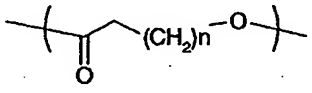
wherein R represents $-A_1-SO_2R_1$, R_1 represents OH, a halogen atom, ONa, OK, or OR_{1a}, R_{1a} and A_1 each independently represent a group having a substituted or unsubstituted aliphatic hydrocarbon structure, a substituted or unsubstituted aromatic ring structure, or a substituted or unsubstituted heterocyclic structure, n represents an integer selected from 1 to 4, m represents an integer selected from 0 to 8, and when multiple units exist, R, R_1, R_{1a}, A_1, m, and n each independently have the above meaning for each

unit.

9. A method of producing a polyhydroxyalkanoate containing a unit represented by the chemical formula (101), comprising the steps of:

allowing a polyhydroxyalkanoate containing a unit represented by the chemical formula (99) to react with a base; and

allowing the compound obtained in the foregoing step to react with a compound represented by the chemical formula (100),

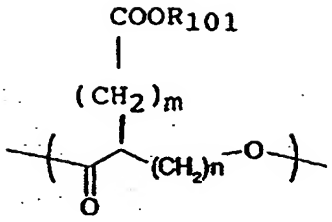


(99)

wherein n represents an integer selected from 1 to 4, and when multiple units exist, n's each independently have the above meaning for each unit,

(100)

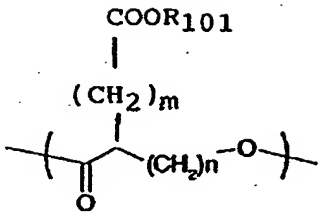
wherein m represents an integer selected from 0 to 8, X represents a halogen atom, R_{100} represents a linear or branched alkyl or aralkyl group having 1 to 12 carbon atoms, and when n = 4 in the chemical formula (99), m is not equal to 0,



(101)

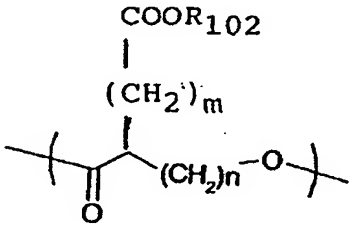
wherein n represents an integer selected from 1 to 4, when n represents an integer selected from 1 to 3, m represents an integer selected from 0 to 8, when n = 4, m represents an integer selected from 1 to 8, R_{101} represents a linear or branched alkyl or aralkyl group having 1 to 12 carbon atoms, and when multiple units exist, R_{101}, m, and n each independently have the above meaning for each unit.

10. A method of producing a polyhydroxyalkanoate containing a unit represented by the chemical formula (102), comprising the step of hydrolyzing a polyhydroxyalkanoate containing a unit represented by the chemical formula (101) in the presence of an acid or an alkali or the step of subjecting the polyhydroxyalkanoate to hydrogenolysis including catalytic reduction,



(101)

wherein n represents an integer selected from 1 to 4, when n represents an integer selected from 1 to 3, m represents an integer selected from 0 to 8, when n = 4, m represents an integer selected from 1 to 8, R_{101} represents a linear or branched alkyl or aralkyl group having 1 to 12 carbon atoms, and when multiple units exist, R_{101}, m, and n each independently have the above meaning for each unit,



(102)

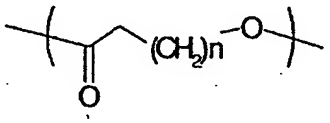
wherein R_{102} represents hydrogen or a group for forming a salt, n represents an integer selected from 1 to 4. when n represents an integer selected from 1 to 3, m represents an integer selected from 0 to 8, when n = 4, m represents an integer selected from 1 to 8, and when multiple units exist, R_{102}, m, and n each independently have the above meaning for each

unit.

11. A method of producing a polyhydroxyalkanoate containing a unit represented by the chemical formula (104), comprising the steps of:

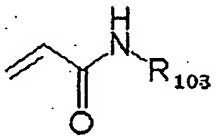
allowing a polyhydroxyalkanoate containing a unit represented by the chemical formula (99) to react with a base; and

allowing the compound obtained in the foregoing step to react with a compound represented by the chemical formula (103),



(99)

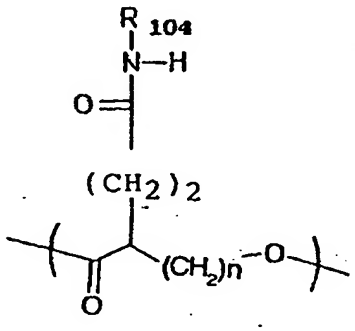
(In the formula, n represents an integer selected from 1 to 4. When multiple units exist, n's each independently have the above meaning for each unit.)



(103)

Wherein R_{103} represents $-A_{103}-SO_2R_{103a}$, R_{103a} represents OH, a halogen atom, ONa, OK, or OR_{103b}, R_{103b} and A_{103} are each independently selected from groups each having a substituted or unsubstituted aliphatic

hydrocarbon structure, a substituted or unsubstituted aromatic ring structure, or a substituted or unsubstituted heterocyclic structure, and when multiple units exist, R_{103}, R_{103a}, R_{103b}, and A_{103} each independently have the above meaning for each unit,



(104)

Wherein n represents an integer selected from 1 to 4, R_{104} represents $-A_{104}-SO_2R_{104a}$, R_{104a} represents OH, a halogen atom, ONa, OK, or OR_{104b}, R_{104b} and A_{104} each independently represent a group having a substituted or unsubstituted aliphatic hydrocarbon structure, a substituted or unsubstituted aromatic ring structure, or a substituted or unsubstituted heterocyclic structure, and when multiple units exist, R_{104}, R_{104a}, R_{104b}, A_{104}, and n each independently have the above meaning for each unit.